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PENSOFT

New record of a natural host of *Anastrepha grandis* (Macquart, 1846) (Diptera, Tephritidae) in Brazil

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Abstract

Sicana odorifera (Vell.) Naudim, or Cassabanana, is reported for the first time as a natural host of the South American Cucurbit Fruit Fly, *Anastrepha grandis* (Macquart, 1846). This paper presents information on this new host and discusses the distribution of *A. grandis* and its hosts in Brazil. In addition, *Cucurbita moschata* is the first host of *A. grandis* recorded in the state of Paraná.

Keywords

Cassabanana, Cucurbitaceae, *Sicana odorifera*, South American Cucurbit Fruit Fly

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Introduction

In Brazil, 121 species of *Anastrepha* Schiner, 1868 are recorded (Zucchi and Moraes 2008), and some of them are of economic importance, such as *Anastrepha grandis* (Macquart, 1846), the South American Cucurbit Fruit Fly. The direct damage caused by *A. grandis* to the fruits does not usually have a significant negative economic impact, as few fruits are destroyed in the plantations. However, *A. grandis* is economically important due to its quarantine pest status, as countries where the species is absent impose quarantine restrictions on the import of cucurbits, especially pumpkins and melons.

Anastrepha grandis occurs mainly in South America, with species records in Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, and Venezuela (CABI 2021). In Central America, it has only been recorded in Panama, in fruits of *Fevillea cordifolia* L. (Cucurbitaceae) (MIDA 2018). In Brazil, the species is distributed in the central and southern regions, with no records from the northern or northeastern regions, except for Bahia state (Bondar 1949). Even in the Brazilian states where it occurs, *A. grandis* has a discontinuous distribution (Montes et al. 2011; Silva et al. 2019). This characteristic has led to the implementation of *A. grandis*-free areas in the northeastern region (Araujo et al. 2000; Silva et al. 2019) and risk mitigation strategies for this species in melon, watermelon, pumpkin, and cucum-

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ber cultivation (SDA 2006).

The attack of *A. grandis* in cucurbit plantations occurs at different stages of fruit development, except in those in the maturation phase. The female introduces the eggs, through the aculeus, in a cucurbit fruit, in which the larvae feed inside the fruit and, once fully developed, they leave the host fruit towards the soil, burying themselves a few centimeters deep, where they become coarctate pupae. *Anastrepha grandis* is the only species of the genus in Brazil whose larvae develop exclusively in native or introduced cucurbits. The main crops it attacks are *Cucumis melo* L. (melon), *Cucumis sativus* L. (cucumber), *Citrullus lanatus* (Thunb) Matsum. & Nakai (watermelon), *Cucurbita maxima* Duchesne (squash), *Cucurbita moschata* Duchesne (pumpkin), and *Cucurbita pepo* L. (zucchini) (Uchoa et al. 2002; Zucchi and Moraes 2008; Veloso et al. 2012; Bolzan et al. 2015) (Table 1).

Some regions of northeastern Brazil, such as Mossoró and Assu in the Rio Grande do Norte state (Araujo et al. 2000) and the region of Baixo Jaguaribe in the Ceará state (MAPA 2003) are considered to be free from of *A. grandis* populations, meaning that they have been able to export cucurbit crops (pumpkin, watermelon, melon, cucumber) to several countries.

Knowledge of host plants is a crucial step in the development of pest management programs. Thus, we are reporting a new host plant record for *A. grandis* in Brazil, and the first record of this fly reared from cucurbit fruits in the Paraná state.

Methods

Fruits of Cassabanana, *Sicana odorifera* (Vell.) Naudim (Cucurbitaceae), were collected in March 2015 at the Department of Entomology and Acarology of the Luiz de Queiroz Campus, Piracicaba, São Paulo (SP) (22°42′45″S, 047°37′36″W, 543 m elev.) (Fig. 1), where they are routinely used to feed the lepidopterans reared in the department's butterfly house. Some larvae were

Table 1. Host plants (Cucurbitaceae) of *Anastrepha grandis* in Brazil.

Regions	States[1]	Scientific names[2]	Common names	References[3]
Northeast	BA	—	—	Bondar 1949
Central west	GO	*Cucumis melo*	Melon	Veloso et al. 2012
		Citrullus lanatus	Watermelon	
		Cucurbita spp.	Pumpkin	
	MS	*Cucurbita moschata*	Pumpkin	Uchoa et al. 2002
	MT	—	—	Lima 1934
Southeast	ES	*Cucurbita maxima*	Squash	Martins 2010
		Cucurbita pepo	Zucchini	
	MG	*C. pepo*	Zucchini	Pirovani 2011
	RJ	*Benincasa hispida*	Wax gourd	Gonçalves 1938
		Cucumis sativus	Cucumber	Lima 1934
		C. pepo	Zucchini	Lima 1927
		C. lanatus	Watermelon	Lima 1934
	SP	*C. lanatus*	Watermelon	Oliveira et al. 2012
		Cucumis anguria	Maxixe	
		C. melo	Melon	
		C. sativus	Cucumber	Souza-Filho et al. 2010
		Cucurbita sp.	Pumpkin	Fisher 1932
		C. maxima	Squash	Souza Filho 1999
		C. moschata	Pumpkin	
		C. moschata × *C. maxima*	Hybrid Pumpkin	Oliveira et al. 2012
		C. pepo	Zucchini	Malavasi et al. 1980
		Lagenaria siceraria	Calabash	Baldo et al. 2017
		L. siceraria	Calabash	Oliveira et al. 2012
		Sicana odorifera	Cassabanana	Savaris et al. 2020
South	PR	—	—	Zucchi 1978
		C. moschata	Pumpkin	This publication
	RS*	*C. lanatus*	Watermelon	Bolzan et al. 2015
		C. moschata	Pumpkin	
		C. moschata × *C. maxima*	Hybrid pumpkin	
		C. melo	Melon	
		C. pepo	Zucchini	
		C. sativus	Cucumber	
		Cucurbita spp.	—	
	SC	*C. pepo*	Zucchini	Garcia and Norrbom 2011
		C. lanatus	Watermelon	

[1]States: BA = Bahia, ES = Espírito Santo, GO = Goiás, MS = Mato Grosso do Sul, MT = Mato Grosso; MG = Minas Gerais, PR = Paraná, RJ = Rio de Janeiro, RS = Rio Grande do Sul (*infested hosts in laboratory), SC = Santa Catarina, SP = São Paulo.
[2]Scientific names according to The Plant List (2013).
[3]First published records.

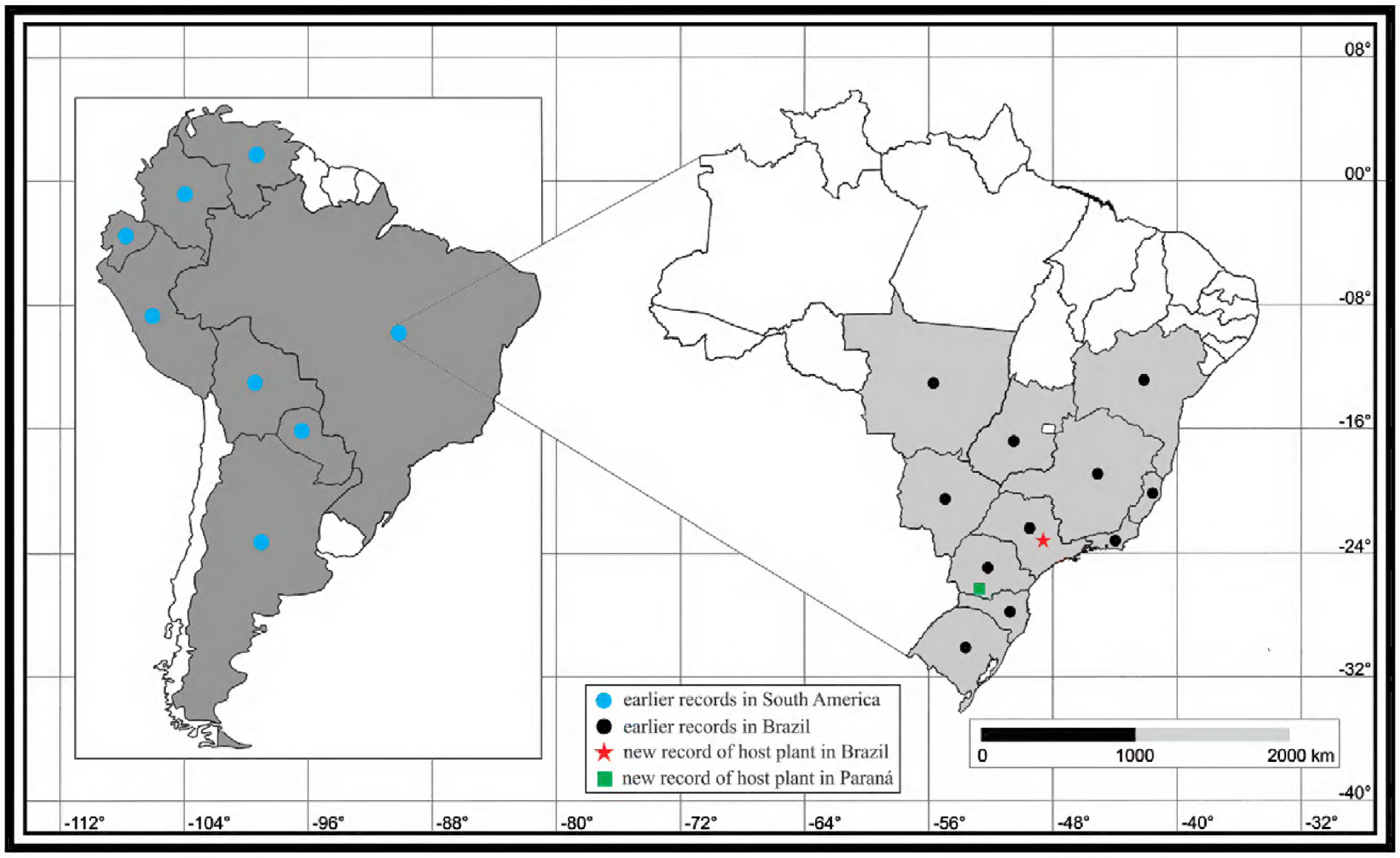

Figure 1. Distribution of *Anastrepha grandis* in South America and Brazilian states (★ = *Sicana odorifera*; ■ = *Cucurbita moschata*).

found in an open fruit intended for feeding the butterflies. From this natural infestation of fallen fruits, three specimens (two males and one female) were collected.

In the municipality of Coronel Vivida, state of Paraná, locality of União do Gigante (26°06′35″S, 052°32′02″W; 606 m elev.) (Fig. 1), adults of *A. grandis* (two males and nine female) were obtained in January 2014 from fruits of *Cucurbita moschata* (pumpkin), grown for the purpose of feeding pigs in a small farm. Fieldwork in Coronel Vivida was supported by the project "Ampliação do conhecimento em taxonomia, sistemática e aspectos biológicos de Tephritoidea (Diptera) na Região Neotropical, em especial das famílias Tephritidae e Richardiidae" and aimed to understand the diversity and distribution of the families Tephritidae and Richardiidae (Diptera) from Brazil. The sampling was supported by the Sistema de Autorização e Informação em Biodiversidade (SISBIO), authorization number 48020. The voucher specimens were deposited in the collection of the Luiz de Queiroz Entomology Museum, Department of Entomology and Acarology, Luiz de Queiroz College of Agriculture (MELQ ESALQENT), University of São Paulo, Piracicaba.

The adults of *A. grandis* were photographed using a Canon EOS Rebel T3i with an EF 100 mm macro lens. The fruit and damage were photographed with an EFS 18–135 mm lens; photographs were enhanced using Photoshop CS6 to correct the color and make minor corrections (e.g., remove debris). The distribution map was made using Quantum GIS 2.8. Geographic coordinates were obtained for each locality using a Garmin 78S GPS receiver.

Results

Sicana odorifera (Cucurbitaceae) is recorded as a new host plant for *A. grandis*. In addition, we present *Cucurbita moschata* as a new host plant record for *A. grandis* in Paraná, state.

New records. BRAZIL – **São Paulo** • Piracicaba, ESALQ; 22°42′45″S, 047°37′36″W; 543 m alt.; 15.III.2015; J.A. Cerignoni leg.; reared from fruits of *Sicana odorifera* (Vell.) Naudim (Cassabanana); 2♂, 1♀; MELQ ESALQENT000246-248 – **Paraná** • Coronel Vivida, União do Gigante; 26°06′35″S, 052°32′02″W; 606 m alt.; 12.I.2014; M. Savaris, S. Lampert leg.; reared from fruits of *Cucurbita moschata* Duchesne (pumpkin); 2♂, 9♀ MELQ ESALQENT000249-260.

Identification. The species identification was based on Zucchi (2000) and Norrbom et al. (2012). The South American Cucurbit Fruit Fly, *A. grandis*, is distinguished from all other economically important species of *Anastrepha* in Brazil by its large size and external morphology, such as the dark stripes on the mesonotum, wing pattern (C-band and S-band broadly connected along costal margin; only V-band proximal arm present), and female terminalia (long aculeus with 5.3–6.2 mm and aculeus tip not serrate) (Norrbom et al. 2012). Additionally, it is the unique among *Anastrepha* species in Brazil in having larvae that exclusively develop in Cucurbitaceae fruits (Zucchi and Moraes 2008).

Geographic distribution. Argentina, Bolivia, Brazil (Bahia, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Rio de Janeiro,

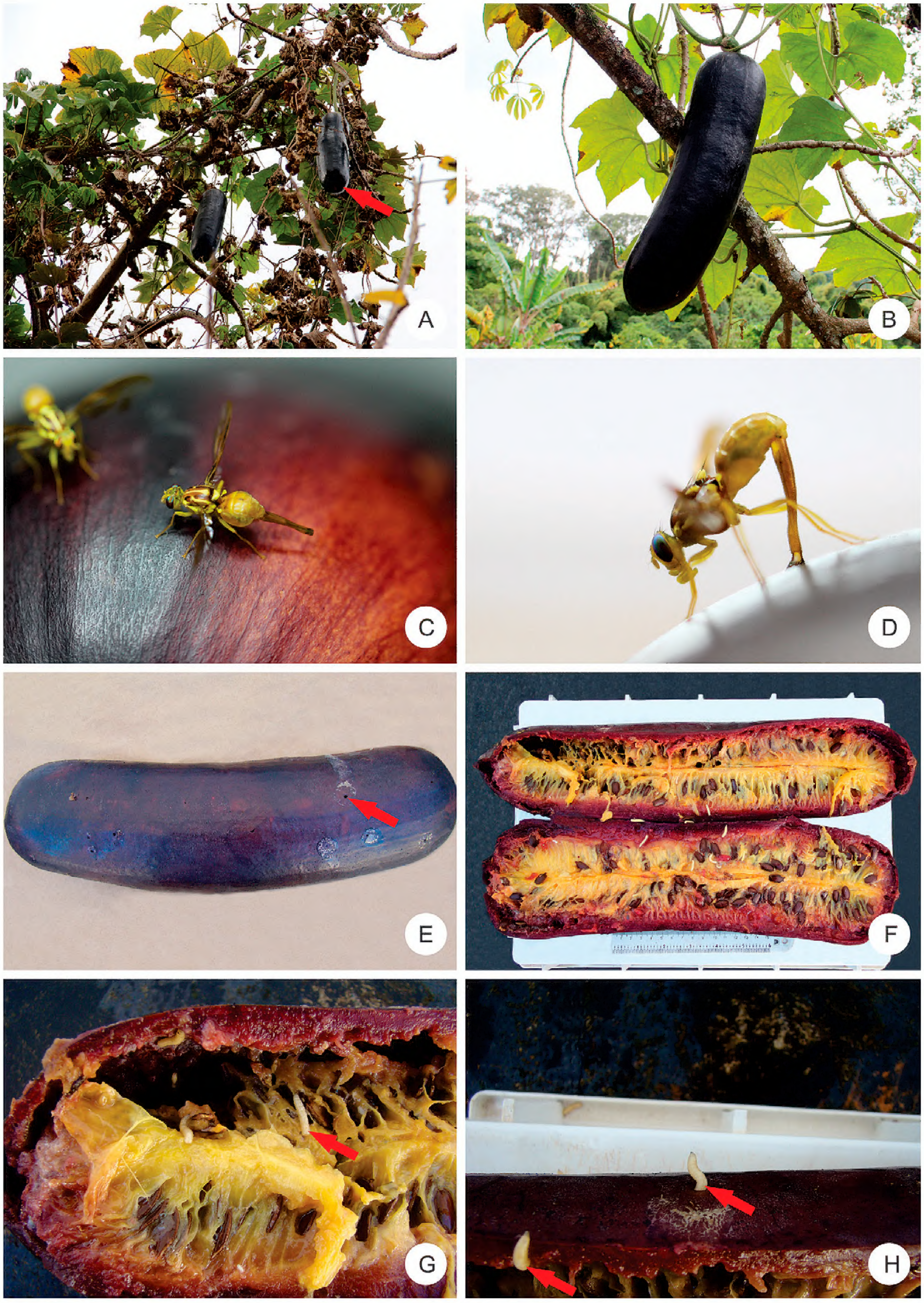

Figure 2. *Sicana odorifera* and *Anastrepha grandis*. **A, B.** Fruit on the climbing plant. **C.** *Anastrepha grandis* (females) on the fruit. **D.** Female ovipositing. **E.** Exit hole opened by larvae **F, G.** Damage to the fruit (arrows indicate larvae). **H.** Larvae leaving the fruit to pupate.

Rio Grande do Sul, Santa Catarina, São Paulo (Fig. 1; Zucchi and Moraes 2008), Colombia, Ecuador, Panama, Paraguay, Peru, and Venezuela (CABI 2021).

Discussion

Anastrepha grandis larvae develop in several Cucurbitaceae species. Here, we document the first records of *S. odorifera* (Fig. 2A, B), as a natural host of *A. grandis*, which has now been recorded in 12 cucurbit hosts (11 species and one hybrid) in 11 Brazilian states (Table 1). Although Duarte (1950) recorded *Sechium edule* (Jacq.) Sw. (Chayote) as a host for *A. grandis*, this record appears doubtful. According to recent studies, *A. grandis* larvae do not develop in Chayote (Kokubu 2012; Bolzan et al. 2015). In Bahia and Mato Grosso, although *A. grandis* was collected in traps, no cucurbit has been recorded as a host (Table 1). In this study, the senior author (MS) observed fruits of *C. moschata* (pumpkin) hosting *A. grandis* in Paraná state at União do Gigante, Coronel Vivida municipality (Fig. 1; Table 1), which is the first host record for *A. grandis* in that state.

In the laboratory, the infestation of Cassabanana by *A. grandis* was also confirmed (Fig. 2C–H). The fruits were collected in the plant and exposed for female oviposition (Fig. 2D). After 40 days, larval exit holes were observed in the fruits (Fig. 2E). A sample of the fruits with infestation symptoms was analyzed, and the damages caused by the larvae were observed (Fig. 2F–H). The larvae feed on the fruit pulp (Fig. 2G) and then make a hole in the epidermis (peel) (Fig. 2F, G), where they come out to pupate on the ground. In the Philippines, where *S. odorifera* has been introduced, fruits were heavily attacked by fruit fly larvae of *Dacus* in 1916, as reported by Morton (1987).

Sicana odorifera is an herbaceous climbing perennial plant which has been introduced in Brazil. It is native to South America and is cultivated in several countries in Latin America and in the southern United States (Schaefer and Renner 2011; Souza and Lorenzi 2019; Chomicki et al. 2020). The fruit is large, smooth, shiny, cylindrical, and orange-red to brown or black (Fig. 2A, B). The pulp is fleshy, juicy, and sweet, with ranging in color from light yellow to orange. The seeds are oval and light brown with dark brown edges. The plant is cultivated sporadically in domestic orchards and is rarely found in markets or natural conditions. The fruits are consumed fresh or used to prepare juices, jams, or jellies and even used for their intense and pleasant scent (Leon 1968; Barbieri et al. 2006; Montano et al. 2007; Priori et al. 2010; Lorenzi et al. 2015; Paula Filho et al. 2015).

Anastrepha grandis is an oligophagous species restricted to the family Cucurbitaceae. The emergence of *S. odorifera* as the natural host of *A. grandis* is an initial stage in the study of this trophic relationship. Therefore, additional studies need to be conducted to understand the role of the Cassabanana in the population dynamics of the South American Cucurbit Fruit Fly, based on the considerations discussed by Aluja and Mangan (2008). Information on natural hosts has direct implications in the development and establishment of agricultural pest management strategies.

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Authors' Contributions

MS, MFSF, WMF, and RAZ designed the study, analyzed the data, and wrote the final version of the manuscript. JAC collected specimens in nature and provided information on the host in the field. MS made the distribution map and plate. MFSF carried out laboratory studies and took photos of the host and fruit fly.

References

Aluja M, Mangan RL (2008) Fruit fly (Diptera: Tephritidae) host status determination: critical conceptual, methodological, and regulatory considerations. Annual Review of Entomology 53: 473–502. https://doi.org/10.1146/annurev.ento.53.103106.093350

Araujo EL, Lima FAM, Zucchi RA (2000) Moscas-das-frutas nos estados brasileiros – Rio Grande do Norte. In: Malavasi A, Zucchi RA (Eds.) Moscas-das frutas de importância econômica no Brasil—conhecimento básico e aplicado. Holos, Ribeirão Preto, Brasil, 223–226.

Baldo FB, Berton LHC, Gisloti LJ, Raga A (2017) New records of *Anastrepha grandis* (Diptera, Tephritidae) and *Neosilba zadolicha* (Diptera, Lonchaeidae) in Cucurbitaceae species in Brazil. Journal of Agriculture and Ecology Research International 13 (2): 1–7. https://doi.org/10.9734/JAERI/2017/36929

Barbieri RL, Heiden G, Neitzke RS, Garrastazú MC, Schwengber JE (2006) Banco ativo de germoplasma de cucurbitáceas da Embrapa Clima Temperado: período de 2002 a 2006. Embrapa Clima Temperado, Pelotas, Brazil, 30 pp. (Documentos 176).

Bolzan A, Nava DE, Garcia FRM, Valgas RA, Smaniotto G (2015) Biology of *Anastrepha grandis* (Diptera: Tephritidae) in different cucurbits. Journal of Economic Entomology 108 (3): 1034–1039. https://doi.org/10.1093/jee/tov056

Bondar G (1949) Moscas de fruta na Bahia. Bahia Rural 9: 26–27.

CABI (2021) *Anastrepha grandis* (South American Cucurbit Fruit Fly). In: Invasive species compendium. CAB International, Wallingford, UK. https://www.cabi.org/isc. Accessed on: 2021-2-5.

Chomicki G, Schaefer H, Renner SS (2020) Origin and domestication of Cucurbitaceae crops: insights from phylogenies, genomics and archaelogy. New Phytologist 226: 1240–1255. https://doi.org/10.1111/nph.16015

Fischer CR (1932) Nota taxonômica e biológica sobre *Anastrepha grandis* Macq. [sic] (Diptera, Trypetidae). Revista de Entomologia 2 (3): 302–310.

Garcia FRM, Norrbom AL (2011) Tephritoid flies (Diptera, Tephritoidea) and their plant hosts from the state of Santa Catarina in southern Brazil. Florida Entomologist 94 (2): 151–157. https://doi.org/10.1653/024.094.0205

Gonçalves CR (1938) As moscas de frutas e seu combate. Ministério da Agricultura, DNPV/SDSV, Rio de Janeiro, Brasil, 46 pp.

Kokubu MCC (2012) Aspectos bioecológicos sobre a mosca-das-cucurbitáceas-sul-americana *Anastrepha grandis* (Diptera: Tephriti-

dae). Master's thesis, Instituto Biológico, São Paulo, Brasil, 74 pp.
León J (1968) Fundamentos botánicos de los cultivos tropicales. San José: Instituto Interamericano de Ciências Agrícolas de la O.E.A., Turrialba, Costa Rica, 487 pp.
Lima AC (1934) Moscas de frutas do gênero *Anastrepha* Schiner, 1868 (Diptera: Trypetidae). Memórias do Instituto Oswaldo Cruz 28 (4): 487–575. https://doi.org/10.1590/S0074-02761934000400002
Lima AMC (1927) Segundo catálogo sistemático dos insectos que vivem nas plantas do Brasil e ensaio de bibliografia entomológica brasileira. Archivos da Escola Superior de Agricultura e Medicina Veterinária 8 (1/2): 69–301.
Lorenzi H, Lacerda MTC, Bacher LB (2015) Frutas no Brasil nativas e exóticas (de consumo *in natura*). Instituto Plantarum de Estudos da Flora, Nova Odessa, Brasil, 768 pp.
Malavasi A, Morgante JE, Zucchi RA (1980) Biologia de "moscas-das-frutas" (Diptera, Tephritidae). II: Lista de hospedeiros e ocorrência. Revista Brasileira de Biologia 40 (1): 9–16.
Martins DS (2011) Diversidade, distribuição geográfica e hospedeiros de moscas-das frutas (Diptera: Tephritidae) no Estado do Espírito Santo, Brasil. PhD thesis, Universidade Federal de Viçosa, Viçosa, Brasil, 136 pp.
MAPA (Ministério da Agricultura, Pecuária e Abastecimento) (2003) Portaria nº 150 de 1 de dezembro de 2003. https://www.adagri.ce.gov.br/legislacao-vegetal-estadual. Accessed on: 2021-1-28.
MIDA (Ministry of Agricultural Development) (2018) Current situation of the suramerican fly of the cucurbitaceas *Anastrepha grandis*, in the Republic of Panama, https://www.ippc.int/static/media/files/pestreport/2018/11/09/A._grandis_en_Panama_EN.pdf. Accessed on: 2021-1-25.
Montano HG, Brioso PST, Pereira RC, Pimentel JP (2007) *Sicana odorifera* (Cucurbitaceae) a new phytoplasma host. Bulletin of Insectology 60 (2): 287–288.
Montes S, Raga A, Souza-Filho MF (2011) Levantamento de espécies de *Anastrepha* (Diptera: Tephritidae) em áreas de cucurbitáceas sob sistema de mitigação de risco. Arquivos do Instituto Biológico 78 (2): 317–320. https://doi.org/10.1590/1808-1657v78p3172011
Morton JF (1987) Cassabanana. In: Morton JF (Ed.) Fruits of warm climates. Creative Resource Systems, Miami, USA, 444–445.
Norrbom AL, Korytkowski CA, Zucchi RA, Uramoto K, Venable GL, McCormick J, Dallwitz MJ (2012) *Anastrepha* and *Toxotrypana*: descriptions, illustrations, and interactive keys. Version: 29 May 2012. http://delta-intkey.com/anatox/intro.htm. Accessed on: 2021-1-25.
Oliveira AS, Souza-Filho MF, Raga A, Almeida AM, Azevedo-Filho JÁ, Garcia MJM (2012) Levantamento de hospedeiros da mosca-das-cucurbitáceas-sul-americana *Anastrepha grandis* (Macquart, 1846) (Diptera: Tephritidae) no estado de São Paulo. In: 10º Congresso de Iniciação Científica em Ciências Agrárias, Biológicas e Ambientas. Biológico, São Paulo, Brazil, 46.
Paula Filho GX, Barreira TF, Pinheiro SS, Morais CL de, Duarte MHS, Pinheiro-Sant'Ana HM (2015) 'Melão croá' (*Sicana sphaerica* Vell.) and 'maracujina' (*Sicana odorifera* Naud.): chemical composition, carotenoids, vitamins and minerals in native fruits from the Brazilian Atlantic forest. Fruits 70 (6): 341–349. https://doi.org/10.1051/fruits/2015035
Pirovani VD, Martins DS, Souza SAS, Uramoto K, Ferreira PSF (2010) Moscas-das-frutas (Diptera: Tephritidae), seus parasitoides e hospedeiros em Viçosa, Zona da Mata Mineira. Arquivos do Instituto Biológico 77 (4): 727–733. https://doi.org/10.1590/1808-1657v77p7272010
Priori D, Barbieri RL, Neitzke RS, Vasconcelos CS, Oliveira CS, Mistura CC, Costa FA (2010) Acervo do banco ativo de germoplasma de cucurbitáceas da Embrapa Clima Temperado: 2002 a 2010. Embrapa Clima Temperado, Pelotas, Brazil, 37 pp. (Documento 295).
SDA (Secretaria de Defesa Agropecuária) (2006) Instrução Normativa nº 16 de 5 de março de 2006 (D.O.U. 12/04/2006). http://www.editoramagister.com/doc_833886_INSTRUCAO_NORMATIVA_N_16_DE_5_DE_MARCO_DE_2006.aspx. Accessed on: 2021-1-28.
Schaefer H, Renner SS (2011) Cucurbitaceae. In: Kubitzki K (Ed.) Families and genera of flowering plants. Springer Verlag, Berlin, Germany, 112–174.
Savaris M, Cerignoni JA, Zucchi RA (2020) Ocorrência de *Anastrepha grandis* (Macquart, 1846) (Diptera: Tephritidae) em *Sicana odorifera* (Vell.) Naudin (Cucurbitaceae). In: XXXIII Brazilian Congress of Zoology, Águas de Lindóia, Brazil, 598.
Silva MA, Silva GCDB, Oliveira JJD de, Bolzan A (2019) Area-wide management of *Anastrepha grandis* in Brazil. In: Pérez-Staples D, Díaz-Fleischer F, Montoya P, Vera MT (Eds.) Area-wide management of fruit fly pests. CRC Press, Boca Raton, USA, 301–314.
Souza VC, Lorenzi H (2019) Botânica sistemática: guia ilustrado para identificação das famílias de fanerógamas nativas e exóticas no Brasil, baseado em APG IV. Jardim Botânico Plantarum, Nova Odessa, Brasil, 768 pp.
Souza-Filho MF (1999) Biodiversidade de moscas-das-frutas (Diptera: Tephritidae) e seus parasitoides (Hymenoptera) em plantas hospedeiras no Estado de São Paulo. Master's thesis, Escola Superior de Agricultura "Luiz de Queiroz", Piracicaba, Brasil, 173 pp.
Souza-Filho MF, Raga A, Montes SMNM, Azevedo-Filho JA, Garcia MJM, Almeida AM, Matioli AL (2010) Cucurbitaceae hosts for natural infestation of *Anastrepha grandis* (Macquart) in the of São Paulo state, Brazil. In: 8th International Symposium on Fruit Flies of Economic Importance, Valencia, Spain, 170.
The Plant List (2013). Version 1.1. http://www.theplantlist.org/. Accessed on: 2021-2-4.
Uchoa MA, Oliveira I, Molina RMS, Zucchi RA (2002) Species diversity of frugivorous flies (Diptera: Tephritoidea) from hosts in the Cerrado of the State of Mato Grosso do Sul, Brazil. Neotropical Entomology 31 (4): 515–524. https://doi.org/10.1590/S1519-566X2002000400002
Veloso VRS, Pereira AF, Rabelo LRS, Caixeta CVD, Ferreira GA (2012) Moscas-das-frutas (Diptera, Tephritidae) no Estado de Goiás: ocorrência e distribuição. Pesquisa Agropecuária Tropical 42: 357–367. https://doi.org/10.1590/S1983-40632012000300015
Zucchi RA (1978) Taxonomia das espécies de *Anastrepha* Schiner, 1868 (Diptera, Tephritidae) assinaladas no Brasil. PhD thesis, Escola Superior de Agricultura "Luiz de Queiroz", Piracicaba, Brasil, 105 pp.
Zucchi RA (2000) Taxonomia. In: Malavasi A, Zucchi RA (Eds.) Moscas-das-frutas de importância econômica no Brasil**:** conhecimento básico e aplicado. Holos, Ribeirão Preto, Brasil, 285–290.
Zucchi RA, Moraes RCB (2008) Fruit flies in Brazil—*Anastrepha* species their host plants and parasitoids. ESALQ/USP, Piracicaba, Brazil. http://www.lea.esalq.usp.br/anastrepha/. Accessed on: 2021-1-26.